Record of Concern/Record of Response for October 27, 2006

To: Richard Levitt
Hydro Project Manager

From: Bob Christensen
Hydro ECM

Summary
This record is being drafted to document concern for environmental impacts associated with construction activities on the Falls Creek Hydro-electric project. Blasting in recent weeks has resulted in 4 slides into Falls Creek. The first slide occurred on October 6th and the most recent slide occurred on October 22nd. The slides have had minimal-moderate immediate impacts on fish habitat, however, slope instability and the threat of further mass wasting is a serious concern in all areas, including blasting areas scheduled for the near future. Two of the slides at the powerhouse area had direct impacts to anadromous fish habitat that may necessitate mitigation. Each of the 4 slides occurred as a result of bedrock blasting for service road construction. Each of these shots were conducted under circumstances where nothing, or a very narrow protective berm existed between the planned shot and the Falls Creek canyon wall. For the purposes of this report these type of shots will be referred to as "daylight shots" (see figures 1 and 2). *A preliminary report on the first two slides was provided via e-mail (including photos) to all relevant agencies immediately following the Blueberry Hill slide on October 12th. FERC responded soon after with a request for a record of concern/record of response to be submitted within 15 days.*

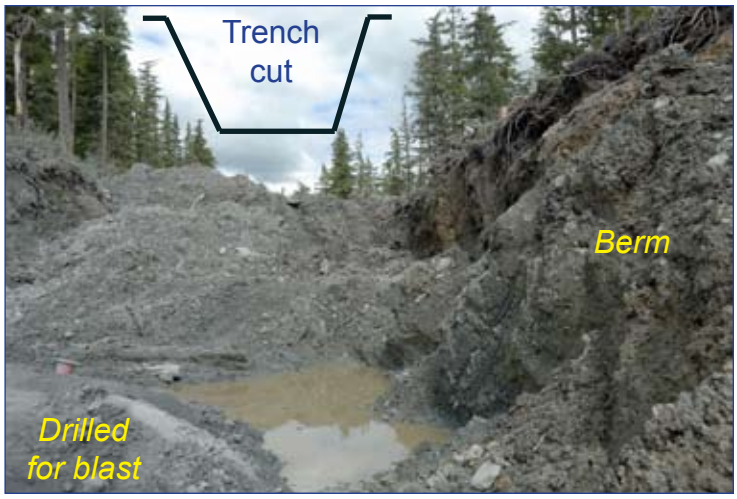

Figure 1: Berm shot in the Blueberry Hill trench cut.

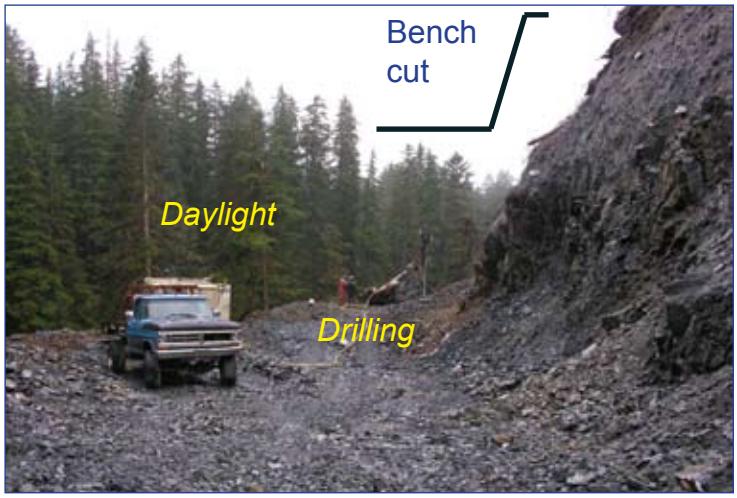

Figure 2: Daylight shot at the powerhouse road bench cut.

Details
The first slide into the creek occurred at the Blueberry Hill road cut area on October 6th (see figure 3.1). A previous record of concern was filed in July when road construction activities first began in this area (see Appendix 2 of the July report). Part of the record of response from the project manager and construction superintendent was to propose moving the road back from a bench cut at the canyon wall to a trench cut approximately 40 feet from the canyon wall (see figure 1). Vegetation, topsoil and bedrock were not disturbed along the canyon wall leaving a large berm between the blasting of the road and the canyon wall. Avoidance of daylight shooting here appears to have worked well for reducing the likelihood of mass wasting in most of this area, however, it was eventually necessary to daylight out into the neighboring valley in order to continue with the intake road up toward the impoundment.

Slide 1 into the creek resulted in a narrow band of the forested slope giving way immediately below the daylight shot and dumped topsoil, trees and rock from the blast down the ~ 200' canyon walls to Falls Creek (see figures 3.1, 3.2, 3.3, 3.4, 3.5). Turbidity was tracked following the event with a peak of 31 NTUs occurring about an hour after the shot. Immediate impacts to fish habitat were minimal.

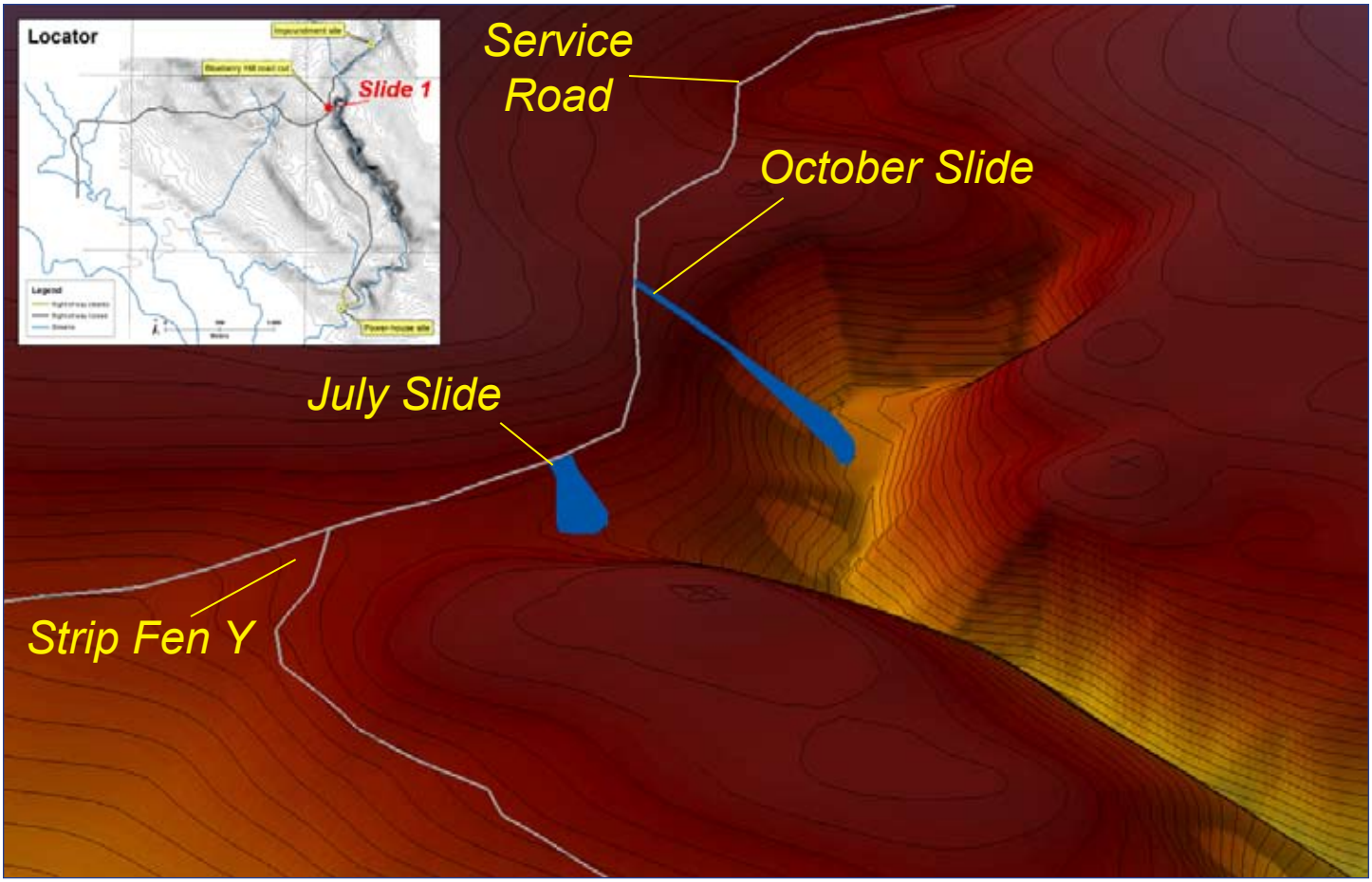

Figure 3.1: Elevation model for the area around the Blueberry Hill road cut. Two slides have occurred in this area: one back in July and one in October.

Figure 3.2: Drilling Blueberry Hill. Here the road exits the trench cut leaving little protective berm between the blasting area and canyon wall.

Figure 3.3: After the shot most of the rock remained humped up on the road bed but some slid down the canyon wall along with topsoils and trees.

Figure 3.4: Looking down from the top of the slide to the creek below. Most of the exposed surface was rocked all the way to the creek.

Figure 3.5: This is a picture of where terminus of the slide enters the creek. Note the downed logs crossing the stream and turbid waters below.

The greatest concern I have for this area is that slope disturbance from this slide may lead to further unravelling and sliding of nearby steeply forested habitats. There are potential marbled murrelet nesting trees in this forest and further slide could temporarily dam the creek below and contribute to increased downstream turbidity. No mitigatory actions have occurred thus far. I am currently recommending that work with matting, vegetation and runoff control be done to stabilize and protect the disturbed slope.

The second slide into the creek occurred at the powerhouse site on October 12th just downstream of the slide reported in September (see figure 4.0, 4.1, 4.2 and 4.3). Though there was a small berm between the shot and the canyon wall the material was largely topsoil and rotten rock and provided little protection of the slope from the blast. This section of the road could have been moved further from the canyon wall after the slide that occurred in September provided a "heads-up" on how unstable this area was but this would have greatly increased the cost of this section of road and would not have guaranteed that no mass wasting would have occurred in this area. Following consultation with the project manager and construction superintendent it was decided that the situation would be handled by modifications of the blasting plan. In particular, the depth of drilling and the amount of explosives used were reduced and lookers were employed for relief.

Slide 2 into the creek resulted in a relatively small amount of topsoil and a few trees entering the creek. Immediate impacts to fish habitat were low with just a small area of potential salmon spawning gravels buried and very little turbidity measured in the aftermath. As with the slide at Blueberry Hill my greatest concern for this area is ***that slope disturbance from this slide may lead to further unravelling and sliding of nearby steeply forested habitats.*** To some degree this concern has been made a moot point because the forested slope downstream of slide 2 was lost as a result of another daylight shot in this area and slide 3 into the creek. No mitigatory actions have occurred thus far. I am currently recommending that work with matting, vegetation and runoff control be done to stabilize and protect the disturbed slope.

Slide 3 into the creek occurred at the powerhouse site on October 19th (see figure 4.0, 4.1, 4.4 and 4.5). Like the slide at Blueberry Hill, this slide also occurred as a result of a daylight shot that was at least partially unavoidable as the road was coming out of the bench cut corner above Falls Creek to descend into the powerhouse valley. Slide 3 occurred in two parts: 3.1) the forested slope immediately between the shot and Falls Creek slid down into the creek, and 3.2) the "topsoil" in the powerhouse valley gave way and slid into the creek when loaded with shot rock. The blasting plan for this area was to lift and throw the rock away from the canyon wall and into the powerhouse valley. The shot went according to the plan but the forested slope was shaken enough to still result in slide 3.1 and the down slope loading of the powerhouse valley unexpectedly resulted in slide 3.2.

Figure 4.0: Aerial view of the powerhouse area that shows the August slide and the locations impacted by slide 2 and slide 3.

Slide 3 into the creek was the largest thus far and resulted in approximately 2,500 yards of topsoil and shot rock covering the creek, as well as several logs and trees. Although potential spawning gravels were not mapped in this location in 2000, recent photos indicate that potential spawning gravels, especially for coho salmon, were likely present in the area now covered by the slide (see Appendix 1 for a figure excerpted from Flory 2000, Resident Dolly Varden, Anadromous Fish Species and Benthic Invertebrates of the Falls Creek Area, part of the PDEA). The impacted area included an island in the center of the stream and a channel along the east side of the island. The terminal lobe of the slide now rests on top of this island and the channel on the east side was completely buried. No mitigatory actions have occurred thus far. Jackie Timothy of the DNR met with me and the project manager on-site to assess impacts and begin a discussion on possible mitigation actions. Plans for mitigation are ongoing and will be described in further detail in a subsequent report.

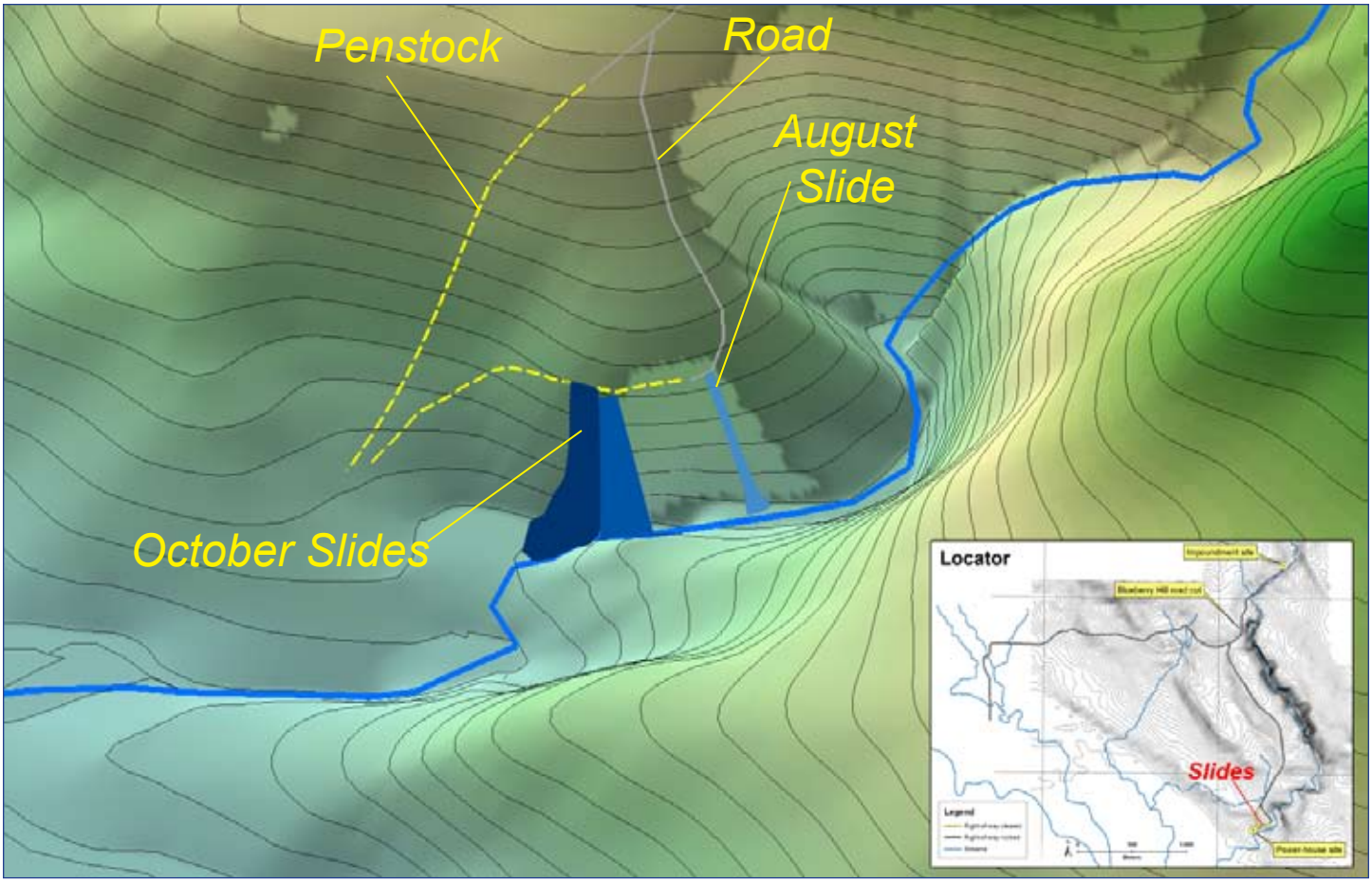

Figure 4.1: Elevation model for the area around the powerhouse road cut. Three slides have occurred in this area: one back in August and two in October.

Figure 4.2: Drilling the road approach tot he powerhouse area. Here the road exits the trench cut leaving little protective berm between the blasting area and canyon wall.

Figure 4.4: View from teh top of slide 3. The topsoils, rock and trees in the foreground are at the terminus of the first part of slide 3 - 3.1. Fish habitat impacted.

Figure 4.3: View from the top of slide 2 into the creek. This slide covered a small area of potential spawning gravels and briefly increased downstream turbidity. Fish habitat was impacted here.

Figure 4.5: View from the top of slide 3. The rock and log pile down in the creek is from the second part of slide 3 - 3.2. Fish habitat was impacted here.

Although it has not been determined if additional shots will be necessary in preparation of the powerhouse site, it is clear that ground disturbing activities will certainly occur in conjunction with anchoring the penstock and building the foundation of the powerhouse structure. The risk of continued mass wasting in this area will remain high throughout additional construction activities and for an undetermined period of time after the completion of construction. Special care during construction will be necessary to minimize impacts to the stream and risk to construction personnel. Proactive measures will likely be necessary for long-term slope stabilization.

Slide 4 into the creek resulted in a small amount of mud and shot rock sliding ~ 20' down from the intake road into the creek (see figures 5.1 and 5.2). Minor impacts to resident fish habitat occurred as well as a short-term increase in downstream turbidity. Considerable blasting work remains along this stretch of service road and at the impoundment site (see figures 5.1 and 5.3). With the exception of the shot that resulted in slide 4, current blasting plans along the road appear to be working fairly well in keeping side-slope material out of the creek. It is important to keep in mind that blasting in such close proximity to the stream and with such unstable materials on the proximal slopes makes for an extremely challenging working environment for the road builders. This was brought to the attention of FERC on-site during their September visit. That having been said, I am much less concerned with the minor impacts that may result from shooting the creek-side road and penstock grade than I am concerned about the potential for a very large mass wasting event during the development of the impoundment site.

The area around the impoundment site appears very problematic in terms of slope stability (see figures 5.4 and 5.5). The slopes are steep and appear to be covered by a fairly deep layer ~1-20' of clays, mucky gravels and thinly bedded topsoils and vegetation. Evidence of ancient and contemporary mass wasting events is prolific in this area. Mass wasting during and after construction are a highly likely. Considerable effort will be necessary to minimize the impacts future mass wasting in this area.

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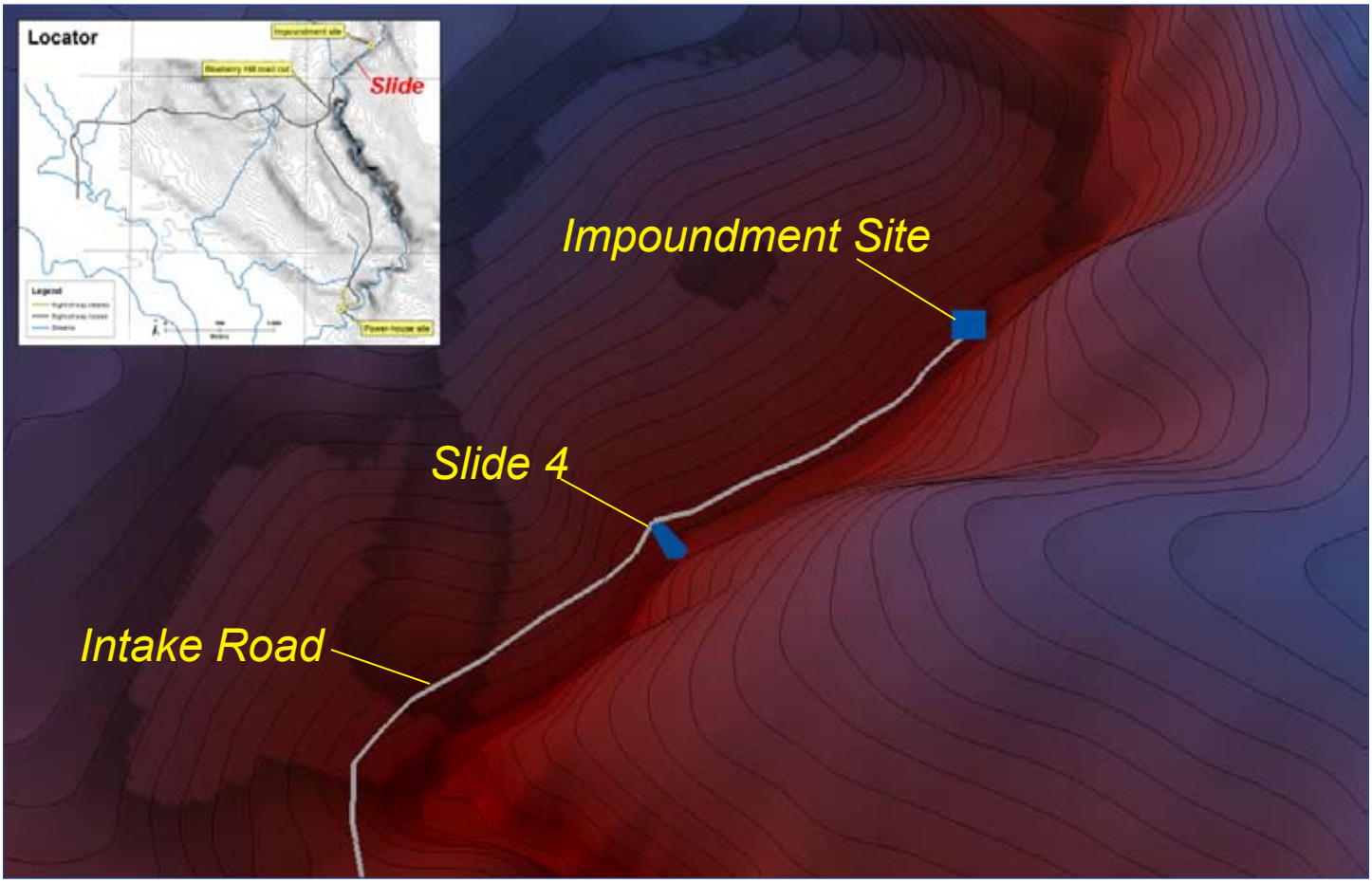

Figure 5.1: Elevation model for the area around the intake road cut and impoundment site. One small slide has occurred here from blasting. The impoundment site will be especially difficult to blast.

Figure 5.2: Small slide of mud and rock (slide 4) from the road-side to the creek. Minimal impacts here.

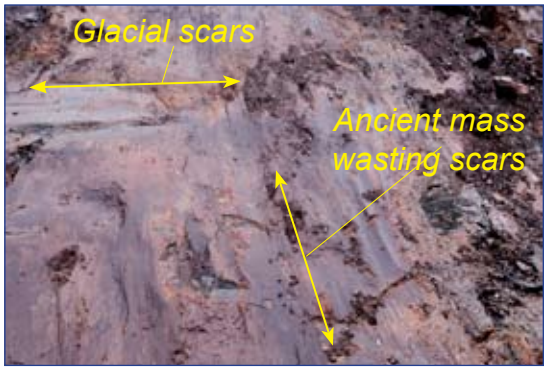

Figure 5.4: Close-up view of the slope at the impoundment site. Horizontal grooves are from previous glaciation, vertical grooves from previous mass wasting events.

Figure 5.3: This picture was taken ~ 500' upstream of slide 4 and provides a good view of the area that needs to be blasted to make penstock grade. Road at right must come down 10-15'.

Figure 5.5: In this shot the track-hoe is excavating the impoundment area. Blasting will be required here. Steep slopes above appear to have a deep layer of clay, weathered clay and topsoil overburden.

Record of Response

To: Bob Christensen
Hydro Project ECM

From: Richard Levitt
Hydro Project Manager

The same concern regarding the potential for mass wasting into Falls Creek exists along the road descending to the powerhouse as existed along the intake road route. Initially, the same precautions were employed on the powerhouse road as were used successfully on the intake road. This included moving the road away from the canyon wall and employing a trench cut rather than a bench cut. It was planned to shoot smaller sections of road to minimize the blast. The blasting plan and timing of charges were to move the rock away from the canyon wall.

In spite of all this, a slide occurred after the first shot. Since the road was moved away from the wall as far as practicable, the size of the shots was further reduced. Eventually, we used 6 shots in the powerhouse road section to blast less than half the road volume that was shot in one blast in the Blueberry Hill area of concern on the intake road. In spite of these precautions, another slide occurred on the 3rd shot.

The last shot, which was to “daylight” the road into the powerhouse “valley”, was to contain the lightest load of all the powerhouse shots. The blasting plan was to move the rock forward into the valley. The shot went according to plan, however most of the remaining slope to the creek gave way. The ravine that received most of the rock that was shot forward slid into the creek with the additional weight of the rock.

The rock in the vicinity of the last shot appears to be more degraded than further up the road. The last shot was lightly loaded and was expected to produce larger size rock for riprap. However, the rock produced was the same or smaller shot rock than preceding shots.

The project superintendent was confident that our blasting plan would not cause these slides. However, he was wrong. It is possible that nothing would have prevented this. The same slope had a mass-wasting event last winter, which was a natural event. There is abundant evidence of natural slides occurring frequently in the area.

The rock buffer between the slope and the road (the center line of the road was 40’ from the slope), which was to remain intact, was so weakened that it was removed as a danger.

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Appendix 1: Figure on spawning gravels in the area of slides at the powerhouse site: Excerpted from the 2000 PDEA